Livestock Grazing & Vegetative Management in the Big 6 Geographic Area

Invasive Plant Species Specialist Report

Prepared by:

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Introduction and Overview of Issues

Invasive and noxious weeds were identified as an issue during scoping. For purposes of this discussion, use of the words *invasive plants* includes noxious weeds and other plants that are not native to the Bighorn National Forest. The Big 6 Geographic Analysis Area consists of five separate projects areas known as Beaver Creek, Goose, Little Horn, Rock Creek, and Tensleep Canyon. For purposes of this report, the term *analysis area* will be used to reference the entire analysis, and the individual project areas will be referenced by name.

This report addresses invasive plant species within the Big 6 Geographic Area Livestock Grazing and Vegetation Management Analysis. It describes the affected environment, and environmental consequences of three alternatives including the proposed action relative to this issue. Issue 8, Invasive and Noxious Weeds is discussed in this report. The indicator is areas of higher risk from new infestations or expansion of existing infestations through the proposed actions of prescribed burning and livestock grazing. This indicator was chosen because disturbed ground through project activities can create an environment for invasive species to establish. In addition, certain activities can contribute to spread of invasive seeds. The remaining issues shown below are discussed and analyzed in other specialist's reports, and therefore are not included in the invasive plant species report.

- Issue 2 aspen stands, Issue 3 riparian vegetation, Issue 4 upland vegetation, Issue 5 Socio/Economic, Issue 6 wildlife, fish and plant TES species, MIS, and species of local concern, Issue 6A bighorn sheep, Issue 7, water quality, Issue 9 range improvement design, Issue 10 heritage resources, Issue 11 scenic integrity, Issue 13 gates being left open.

Legal and Administrative Framework

The legal and administrative framework for noxious and non native species management includes, but is not limited to, the following:

- Federal Noxious Weed Act of 1974.
- February 3, 1999 Executive Order of Invasive Species
- FSM 2060 Ecosystem Classification, Interpretation, and Application
- FSM 2070 Biological Diversity
- FSM 2080 Noxious Weed Management
- FSH 2090.11 Ecological Classification and Inventory Handbook
- FSM 2150 Pesticide-Use Management and Coordination
- FSH 2109.14 Pesticide-Use Management and Coordination Handbook
- FSH 2509.13 Burned-Area Emergency Rehabilitation Handbook
- Wyoming State and County Declared Noxious Weeds (2008)
- Bighorn National Forest Noxious Weed Management EA (1998)
- USDA Forest Service Guide to Noxious Weed Prevention Practices (2001)
- Bighorn National Forest Invasive Species Action Plan (2008)
- Bighorn National Forest Revised Land and Resource Management Plan (2005)

Invasive plants are defined under Executive Order 13112 as "an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health." The National Invasive Species Information Center describes introduced species as those "that can thrive in areas beyond their natural range of dispersal. These plants are characteristically adaptable, aggressive, and have a high reproductive capacity. Their vigor combined with a lack of natural enemies often leads to outbreak populations."

Noxious weeds are plants so designated by the Secretary of Agriculture or by the responsible state official. They generally possess one or more of the following characteristics: aggressive and difficult to manage, poisonous, toxic, parasitic, a carrier or host of serious insects or disease, and native, new to, or not common to all or part of the United States. In a general sense, they are plants that are usually not native to the area in which they are growing and whose growth is so rapid, dominant, or toxic they out-compete native plants, often taking over complete site or ecosystems over time. They seldom have any natural predators, hastening their spread. (FEIS Bighorn National Forest Revised Forest Plan, 2005). Appendix A lists the Designated Species within the State of Wyoming.

Information used in development of this report came from 2150 files, County Weed and Pest District treatment and inventory information, GIS database, Forest Service surveys, and personal knowledge of resource specialists on the districts. Information obtained from these sources includes individual invasive species populations and locations, as well as treatment sites.

Published literature was used to analyze potential effects of the alternatives and included such information as biology and management of invasive species, impacts of invasive species, and processes of invasion. The Bighorn National Forest Plan Revision FEIS (2005) and Bighorn National Forest Noxious Weed Management EA (1998) are both incorporated by reference in this document. The Bighorn National Forest Noxious Weed Management EA (1998) estimated that 95% of the noxious weed sites on the Forest occurred where human activity caused some form of soil disturbance. Invasive plant species most commonly become established in areas where ground-disturbing activities have created bare ground or weakened the desirable plant community's vigor and a seed source is already present or is transported into the area (Masters and Sheley, 2001). Invasive species can be extremely competitive in establishing in disturbed sites, and in addition they are often prolific seed producers. The affected environment section below describes specific areas within the analysis area where invasive species are known to occur, and are likely to establish in the future.

Affected Environment

Existing Condition

Invasive plant species are present within the Big 6 Analysis Area and include the following "designated noxious weeds" within the state of Wyoming (W.S. 11-5-102(a)(xi) and 11-12-104): whitetop, oxeye daisy, leafy spurge, yellow toadflax, spotted knapweed, common burdock, field bindweed, houndstongue, perennial sowthistle, Russian knapweed, Russian Olive, Canada thistle, musk thistle, scotch thistle, common tansey, , perennial pepperweed, salt cedar, dalmation toadflax. In addition, the following species are present, are considered invasive, and/or are on a County Weed List as declared noxious weeds: bull thistle, cheatgrass, water hemlock, milkweed, pennycress, wild licorice, and Japanese knotweed. The Bighorn National Forest Invasive Species Action Plan (May 2008), outlines the five (5) priority species as yellow Toadflax, spotted

knapweed, leafy spurge, oxeye daisy, and whitetop. The existing condition within the five project areas, in relation to invasive plants, is described in detail below.

The Little Horn project area contains invasive species, but none of the Bighorn National Forest's five priority species are known to be present. The primary invasive species present includes houndstongue, cheatgrass, and Canada thistle. Additional species of Scotch thistle, bull thistle, and musk thistle are also known to occur in the area, but populations are smaller in size and occurrence. Within this project area, the Little Horn II wildfire occurred in 2003, and surveys of Fisher Mt. C&H in 2009 found populations of cheatgrass, musk and Canada thistle present in some areas where the timber had formerly been. These populations were previously unknown. The Little Horn C&H, Sage Basin C&H, and Dry Fork Ridge C&H allotments also contain infestations of houndstongue, Canada thistle and musk thistle which occur mostly along and adjacent to some roads and trails. This includes trails used by livestock and recreationists such as Third Crossing (#096), Dry Fork (#004), and Little Horn (#050) trails. Immediately outside of the Little Horn project area (particularly outside the Dry Fork Ridge C&H allotment boundary), are additional infestations of these species along travel routes including Forest Development Roads (FDR) # 167 and #149 which have potential to spread.

The Beaver Creek project area contains few populations of invasive species. Of the five priority species on the Forest, only one known population of whitetop is present and it was treated in 2009. The rest of the known invasive species consist of field bindweed, musk, and Canada thistle. Outside the Beaver Creek project area invasive species exist within approximately 0.25 miles of the forest boundary on private and BLM lands in the vicinity of South Beaver Creek, Hudson Falls, and Dry Fork Horse Creek areas, and have the potential to spread onto the forest through recreational uses or livestock trailing via forest trails #102, 103, 149 or FDR #213 (Dugway). The species present include spotted knapweed, Russian olive, and Canada thistle. In addition, Shell Canyon lies about 1.5 miles south of the Beaver Creek project area and contains cheatgrass, bull thistle, Canada thistle, musk thistle, spotted knapweed, whitetop, common burdock, and Russian olive which could possibly spread though recreation use up the Cedar Creek (#055) or Grouse Creek (#381) trails into the project area. The potential for spread into the project area is considered not very likely due the lack of use on FTR #381 and topography along #055 prevents access to the majority of the project area.

The Tensleep Canyon project area has infestations known to occur along some roads and trails, including old US Highway 16 (FDR #108), FDR #499, and Sand Draw (FDR# 436). Houndstongue is the primary species found in these areas and is located within Tensleep Canyon C&H, North Canyon C&H, and South Canyon C&H allotments. Yellow toadflax has been found and treated on both private and forest lands on and adjacent to the Dry Tensleep C&H allotment. On private lands within 0.25 miles or less of the Monument C&H allotment, some additional populations of invasive species have been known to occur including houndstongue and Canada thistle and have the potential to spread on forest.

The Goose Creek project area has known populations of invasive species along the Big Goose Road (FDR#226) including houndstongue, black henbane, Canada thistle, and sulfur cinquefoil. Knapweed is known to occur in the Poverty Flats area near the forest boundary, but the permittee hand pulled the few known plants and has been actively monitoring the area for new occurrences. In addition, invasive species exist on private lands along the Red Grade Road within ¾ miles of the Forest boundary. This road becomes the Big Goose road when it enters the Forest, and invasive species present along this road on private lands include houndstongue, Canada thistle, and field bindweed.

The Rock Creek project area has had populations of leafy spurge, spotted knapweed, houndstongue and Canada thistle on the edge of the Forest Boundary, including Forest, private,

and state lands. The populations have been found along trail #133 (Face) and are also known to occur both on and off forest in Johnson Creek and French Creek, and off forest on the north fork of Spring Creek. On the southern edge of the project area, there are populations of Canada thistle, musk thistle, and licorice found along FDR #368 French Creek Road.

The areas populated by these invasive plants were derived from recent inventory efforts (2005, 2006, 2008, and 2009) and treatment locations (1999-present). Data was obtained from the Forest GIS database. It is assumed that there are additional acres of invasive species that have not been documented, and as a result the species present and/or locations of occurrences would be expected to change as the Forest continues to gain a better inventory. In addition, the treatment records do not reflect if a single plant or population of plants was eradicated or reduced in size. Therefore, it is assumed that all populations have been contained or controlled through past treatment efforts, and will continue to have treatments on these sites. It is also assumed that some locations of species may be duplicate records since GPS units may not record the exact same point even if the person is in the exact same spot. This could lead to a duplication of some acres; however it is thought that this occurrence is likely to be less than 5% duplication.

Additional efforts the past two years have focused on surveys within the Little Horn watershed and Shell Creek watershed with the Big Horn County Weed and Pest District. These surveys have provided a more complete picture of the invasive plant infestation within Shell Canyon, a portion of the west slope of the Big Horn Mountains, and portions of the Little Horn watershed. In addition, infestations of invasive species are known to occur on lands adjacent to the national forest including BLM, state, and private lands.

Sources of invasive species establishment and/or spread within the analysis area include transportation systems, timber harvest activities, wildfire, prescribed burns, recreation, livestock, and wildlife, and riparian and utility corridors. These are described in more detail below.

Forest roads, main highways, gravel roads, and undeveloped two track user created routes are one of the main areas where invasive species are found within the analysis area. The major arterials with invasive species populations are discussed above by project area. Roads are disturbed sites that offer a continual seedbed of soil free of other competing plants, and the high frequency of human use through vehicle travel provides opportunity for spread and dispersal of reproductive parts into adjacent areas. With the increased use of Off Highway Vehicles (OHVs) on the Forest, there is a greater threat of dispersal into more remote areas due to improved access with these types of vehicles. In addition, with the increased use of the Forest from recreationists from other counties and states, the potential for introduction of other invasive plants not already on the Forest exists.

Timber harvest activities include ground disturbance and soil scarification through development of skid trails, landings, and temporary roads. Once a harvest is completed, it is assumed that invasive species would occupy less than 10% of the disturbed areas. Based on my observations, it appears that about 20 years post sale, the natural revegetation of grasses and trees tends to out-compete the majority of any invasive species that had established. It remains difficult to determine the risk associated with timber harvesting to non-native plant invasion (2004, USDA Forest Service). New sales are planned within the analysis area that could lead to an increase in invasive species; however these sales are not part of the proposed action. Harvest equipment and logging trucks coming from other parts of the country, have the potential to introduce invasive species in future sale areas.

There have been approximately 31,458 acres burned by wildfires within the analysis area from 1989-2009. Fire in shrub or tree land can open up niches previously dominated by shrubs and trees, which would reduce competition in these niches, and allow invasive plant species to establish (Jacobs and Sheley, 2003). The removal of canopy cover that provides overstory shade

can allow invasive species a competitive advantage (Masters and Sheley, 2001). An example of this within the analysis area is the Little Horn II Fire which occurred in 2003. Surveys in 2009 found areas of cheatgrass, Canada thistle and musk thistle where trees and shrubs had previously dominated areas prior to the Little Horn II Wildfire. The fire did not carry seeds from outside the area, but likely opened up the niches where weed seed had been laying dormant in the soil waiting for the opportunity to germinate under the right conditions. The Current Landscape Condition of the Bighorn National Forest describes the association between wildfire hazard and invasibility of non-native plants (Regan et al, 2004).

Recreational uses within the analysis area have potential for establishment and spread of invasive species, due to the high human activity. Known invasive species infestations occur along established trails within the analysis area. For example, the lower portions of the Little Horn Trail, Third Crossing Trail, and Dry Fork Trails are all known to have invasive species along them, which includes houndstongue, cheatgrass, and Canada thistle. The Little Horn and Dry Fork Trails receive a fair amount of recreational use from the bottom end during the spring and summer from hikers, outfitter guides, and special use events (Little Horn Trail Run). Invasive plant reproductive parts can be transported on clothes, cinches, or the coat and hooves of horses, llamas, and dogs. Recreation pack stock and horse users have commonly brought in seeds in hay and animal feed. With the improvements in OHVs, use has increased over the past several years on the Forest. These vehicles have improved accessibility to more remote areas on both roads and trails, which increases the potential for invasive plant parts to be dispersed. In particular, with increased use on trails and illegal off road use, new populations of invasive species may not be detected in a timely fashion and the potential for establishment of larger populations is possible. Within the analysis area, the lower end of these three trails are not open to motorized uses, so where the known infestations are, the opportunity for spread through recreational activities is thought to be minimal.

Livestock concentrations areas such as stock drives, water developments, and corrals can create a seed bed due to soil disturbance from hoof action, which creates opportunities for invasive species establishment. Known invasive species within the analysis area exist along some of the stock drives that come up from private lands below and include Little Horn, Third Crossing, and Dry Fork Trails and along US Highway 16 up Tensleep Canyon. In addition, other trailing routes from private lands have the potential for invasive species to establish, or spread if already present. These could include the following: 1) trailing route of Rock Creek permittees from private land to the forest, 2) trailing route of sheep permittees on Hazelton S&G, Babywagon S&G, Garnet S&G, Upper Meadows S&G allotments up the stock drive along the Gold Mine Road, 3) trailing route of South Canyon C&H & Monument S&G permittees from private, 4) trailing route of permittees on Tensleep Canyon C&H from private, 5) trailing route of permittees on Dry Tensleep C&H from private, 6) trailing route of permittees to West Pass allotment comes from private and joins FDR#428 at Forest Boundary, 7) Soldier Creek Trail #015 provides access to Walker Prairie allotment 8) Big Goose Trail #017, 9) Beaver Creek Trail #149 provides access to Whaley Creek S&G 10) US Highway 14A provides access to sheep allotments within Beaver Creek project area 11) several folks trail across the forest; usually non-permittees & may not be same year to year.

Riparian corridors and stream systems receive a high degree of use by humans, wild, and domestic ungulates. Invasive species in riparian corridors can spread downstream through the flow of water for miles. Russian olive and salt cedar are water loving species and are very invasive in riparian corridors once established. Infestations of invasive species along riparian corridors could reduce ecological and riparian function, causing an impact to fish habitat and lands downstream. Within Tensleep Canyon, houndstongue is fairly common and has the potential to spread downstream rapidly if the populations were to become established near the

water's edge or weed seeds are deposited via trailing or hiking. Outside the analysis area, and within 1 mile of the forest boundary on the west slope of the Bighorns, infestations of invasive species within riparian corridors in Shell Creek, Beaver Creek and Bear Creek are present. The threat to Forest lands within the analysis area is considered low because water flows downstream away from the forest. There may be a slight risk of transportation from humans and livestock going up the drainages, however only Shell Canyon contains a major stock drive and livestock do not trail up it onto the analysis area.

Power line and utility corridors have the potential for establishment of invasive species due to the ground disturbance associated with construction. Within the analysis area, there is one existing utility corridor that runs from High Park Lookout to private lands through the North Canyon C&H allotment. In 2006, a portion of new power cable was buried within the existing right of way and design criteria were established for revegetation. Some Canada thistle was observed the following year, and observations in 2009 in one area noted revegetation had been largely successful (Gall, 2009 photo).

Desired Condition

The desired condition is to "…limit further expansion or new infestations of invasive species and reduce existing infestations of invasive species" (Forest Plan strategy 2 page 1-5).

The desired condition for portions of the project area within the Cloud Peak Wilderness is no invasive plant species population. In portions of the analysis area that are within the wilderness, there are no known invasive species populations. The only known population of noxious weeds adjacent to the wilderness is well outside the analysis area.

Overall, the Bighorn National Forest has relatively few occurrences of invasive plants today. (Regan, et al. 2004). Due to the low amount of invasive species, there has correspondingly been little to no impact upon botanical and wildlife species habitat or vegetative productivity.

A probability invasibility GIS model analysis was conducted for the Forest Plan revision. That analysis considered currently known invasive species locations; existing vegetation types; anthropogenic influences; and, landtype association. Figure M4D-3, page 285, indicates that less than 20% of the Bighorn NF is at high or very high risk of invasibility. (Regan, et al, 2004).

Environmental Consequences

Methodology

In order to evaluate the effects of the proposed actions of livestock grazing and vegetative treatment, the following will be used to describe the effects of alternatives on invasive plant species.

- Acres of potential bare soil and/or ground disturbance due to non-structural range improvements (prescribed fire)

Spatial and Temporal Context for Effects Analysis

In order to more clearly analyze effects of livestock grazing on resources it is necessary to define timeframes that effects would occur within. In this report, short-term effects refer to those occurring within, or lasting five years or less. Long-term effects refer to those occurring after or lasting greater than five years.

Direct, indirect, and cumulative effects to invasive plant species are evaluated within the analysis area. A vicinity map and map of allotments are located in the associated Environmental Impact Statement (EIS).

Effects Definitions

Direct environmental effects are those occurring at the same time and place as the initial cause or action. Indirect effects are those that occur later in time or a spatially removed from the activity, but would be significant in the foreseeable future. Cumulative effects result from incremental effects of actions, when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions. Reasonably foreseeable is defined as the life of the analysis document – in this case 15 to 20 years.

Cumulative effects can result from individually minor, but collectively significant actions taking place over a period of time. Cumulative effects analysis involves assumptions and uncertainties. Cumulative effects analysis provides the opportunity to evaluate future management options in the context of other developments in the analysis area. The sum of effects from individual activities in addition to those of the alternative being analyzed must be measurable in order to be considered a cumulative effect. The boundary for cumulative effects analysis is the analysis area unless otherwise stated.

Effects are analyzed assuming all applicable Best Management Practices (BMPs) are being met. If BMP's were not met, there would be additional environmental effects. Monitoring is intended to measure BMP implementation and effectiveness, and adjustments to livestock grazing would be made based upon this monitoring through the Bighorn National Forest Vegetation Grazing Guidelines (2007).

Review of Potential Effects from Livestock Grazing

This section illustrates the range of direct and indirect effects considered during effects analysis. The effects reviewed are some of the most commonly documented resulting from livestock grazing. This is not a comprehensive review of effects of livestock grazing on invasive plant species. This review is not an effects analysis. Analysis of effects occurs in later sections of the report.

The presence of noxious weeds within any given watershed system presents a risk to riparian and aquatic health and to the vegetative conditions of the upland plant communities. The potential impact may be either direct by noxious weed infestations and alteration of plant community composition and density, or indirect through increased soil erosion (certain species of noxious weeds do not have the same capability to hold and protect soil as native vegetation).

The Air, Soils, Geology Specialist's Report found in the project file describes affects of livestock grazing and prescribed fire on the soil resource. It describes both soil disturbance and ground cover effects and was reviewed and is incorporated by reference in this report. Key information carried forward from the Air, Soils, Geology report to the invasive plant species report include the following: "Livestock grazing can directly cause an increase in soil compaction (Belsky et al. 1999). Trampling of soils via hoof action (Wienhold et al. 2001) and the reduction of litter and organic matter can lead to an increase in soil compaction. Trampling and reduction of litter and organic matter can lead to lower infiltration rates, higher runoff, reduced plant productivity, and reduced cover of soils by plants (Belsky et al. 1999). A vigorous plant community leads to greater root density, mass, and depth, which in turn provides greater resistance to erosion and streambank compression and shear (Clary and Kinney 2002). Heavy livestock grazing affects species composition (Wienhold et al. 2001) which can lead to a less vigorous plant community."

Invasive plant species can impair ecological functions and alter vegetation composition, such as nutrient cycling and energy flow (Masters and Sheley, 2001). Soil texture can be changed, affecting soil moisture regimes. Serious weed infestations degrade soil stability. Surface runoff and sediment yield can be increased substantially (Lacey 1989).

Livestock grazing can facilitate propagation of some invasive plant species by reducing competition of native vegetation. Foraging preferences by different kinds of livestock can alter the plant community. For example, cattle preferentially graze grasses that can lead to a plant community shift to forbs and shrubs. Invasive forbs and shrubs that are not palatable to livestock can benefit from this shift through reduced competition and enhanced habitat (Olsen, 1999). Therefore it is important to maintain a healthy native plant community, which can be done through proper livestock grazing (Sheley et al, 1999). This would include such things as following the Bighorn National Forest Vegetation Grazing Guidelines (2007), changing season of use, and providing for adequate plant recovery.

Conversely, livestock can suppress some invasive plant species by grazing early in the growth cycle, with moderate to heavy intensity. DeBruijn and Bork (2006) showed a significant reduction in Canada thistle when intensely grazed during the growing season. Cuomo et al. (1999) recorded a lower frequency of thistle (Carduus and Cirsium spp.) in the grazed plots than in the ungrazed control. Livestock trampling can also reduce growth and vegetative reproduction of invasive plant species (Krueger and Sheley, 2003).

Fire in shrub or tree land can open up niches previously dominated by those species and reduce competition in these niches, allowing invasive plant species to establish (Jacobs and Sheley, 2003). The removal of canopy cover that provides overstory shade can allow invasive species a competitive advantage (Masters and Sheley, 2001). One example of this is with toadflax, in which Jacobs and Sheley (2003) found it increased on native rangelands treated with prescribed fire. On the other hand, it has also been found that with proper timing and intensity, prescribed burning can be used to enhance the desirable plant community. A vigorous native plant community can out-compete noxious weeds after a prescribed burn. Prescribed burning to enhance the native plant community can reduce spotted knapweed (MacDonald et al., 2007) and will not increase Canada thistle populations (Travnicek et al., 2005).

Some invasive plant species use livestock and wildlife as a pathway for dispersal. This can occur in one of two ways, either through the digestive tract where ingested seeds are unaffected and passed out, or by weed seeds attaching to the coats or hair of animals and dropping off in another area. Viability of weed seeds varies by species and most are destroyed in the digestive tract, however 5 to 15% of leafy spurge and spotted knapweed seeds will pass through the digestive tract of sheep, goats, and mule deer and some of these remain viable (Olson et al. 1997, Wallander et al. 1995). Houndstongue seed, cheatgrass seed, and thistle parts are examples of weed seeds that can be transported by clinging to livestock coats. Dispersal by birds is also a cause. Spreading weed infestations could limit forage, cover, and habitat available to wildlife.

Connected Actions, Past, Present, and Foreseeable Activities Relevant to Cumulative Effects Analysis

The table of past, concurrent and reasonably foreseeable actions in the FEIS was used to determine actions relevant to cumulative effects analysis for the invasive plant species resource. The cumulative effects table can be found in Chapter 3 of the EIS and was used to determine the actions that are relevant to cumulative effects analysis for invasive plant species. They have been summarized into general categories in the table below (not in order of relative importance) and a rational has been provided as to why they were considered relevant or not relevant for analysis of invasive species.

Table 1: Relevance of Past/Present/Foreseeable Activities to Cumulative Effects Analysis

Project	Cumulative Effects Relevant	Rational for relevance
Wildfire/Prescribed Fire/WUI Fuels/Suppression	Yes	Cumulative with past, present, future fires, suppression activities, WUI which can create bare ground through removal of vegetation and provide germination sites.
Dispersed Rec/Outfitter & Guide	Yes	May add cumulatively with use of ATVs/RTVs increasing with public and O&Gs which can all carry invasive plant parts on vehicles.
Private Land inclusion (Dry Tensleep allotment area)	Yes	Noxious weeds are present in this in holding and could be carried on to forest by livestock which would be a minor incremental effect.
Livestock Trailing from private across forest	Yes	Minor incremental effect may be expected with livestock as a vector for spread of invasive species, if they are present.
Timber Sales/Thinning/Salvage	Yes	Creates bare soil and potential germination sites for invasives. Design criteria of sales calls for cleaning equipment before entering units.
Livestock Grazing Activities Forest wide	No	Livestock grazing on adjacent allotments to the analysis area is not expected to add cumulatively. Areas of bare soil that exist through livestock grazing and associated activities are expected to improve by following grazing guidelines, adaptive management strategies, and BMPs. In addition, ongoing treatment of noxious weeds is expected to continue through agreements with counties. Therefore no cumulative effects are expected to occur.
Aspen Regen/conifer encroachment	No	No bare soil created or equipment used that would spread or introduce invasives
Insect & Disease	No	No bare soil created or equipment used that would spread or introduce invasives
Noxious Weed Treatment	No	Maintains, reduces, and/or eradicates existing and new populations.
Fisheries & Riparian Projects	No	These projects have already occurred years ago and/or there are no disturbances associated with them. No incremental cumulative effects expected.
Bighorn Sheep reintroduction/Move domestics	No	Projects have already occurred and no incremental effects are expected. Domestics were already grazing the area prior to the move of domestic sheep so this would not add incrementally.
Med Wheel NHL	No	There is no ground disturbance associated with this project.
Hunt Mt Travel Management	No	This project designated travel routes for motorized use and decommissioned user created roads in an area where they previously could drive anywhere they wanted to. This would not add cumulatively because by designating routes and decommissioning roads areas of bare soil are reduced, and potential spread of invasive species is reduced now to designated routes, assuming users adhere to travel management rules.
Sage Grouse	N	There is no ground disturbance associated with this

Conservation Plan		project.

Alternative 1 – No Action

No livestock grazing would be permitted on any of the allotments under Alternative 1. Range improvements such as fences, gates, corrals, and cattleguards would be removed as time and funding allows. Stock tanks, spring developments, pipelines, and other water systems would also be removed; unless it was determined they were needed for wildlife. Treatment of noxious weeds would continue as funding would allow under the forest noxious weed program.

Design Criteria

No design criteria for Alternative 1 beyond that described in Chapters 1 and 2 of FEIS.

Direct Effects and Indirect Effects

Active allotments

Under Alternative 1, livestock grazing and associated activities (bedgrounds, salting, trailing) would no longer cause disturbances that result in bare ground, reduced productivity/vigor of herbaceous vegetation, and reduction in litter. With no livestock grazing or trampling of vegetation, litter would accumulate more rapidly, bare ground would re-vegetate, and plant communities would shift towards late succession. Plant productivity and vigor would improve in areas where it had been negatively affected by livestock, and healthier native species would be more competitive with existing invasive species populations. New infestations would still have the potential to establish due to existing seed sources which could be spread through other multiple use activities such as recreation, timber harvest, and wildlife.

The removal of structural range improvements would increase bare ground in the short term. For example, stock tanks inhibit plant growth underneath them and when removed there would be bare soil in the short term and would also be very small in size. The increase in bare ground could lead to invasive species propagation if seed is already present or is carried into the area, however the risk is expected to be low due to the small size of the area of disturbance.

Invasive species, such as Canada thistle and cheatgrass that had been grazed if the timing of livestock in a pasture was right would no longer occur. Without grazing by livestock, there is potential for a slight increase in some weed seed production and dispersal for species like Canada thistle and cheatgrass, however this is not expected to be a measurable effect because grazing of these species is variable across the landscape and very limited in any type of concentrated use.

Since livestock are one of several vectors for invasive plant dispersal, removal of livestock would eliminate one dispersal source, which would reduce the potential of new infestations. In addition, work associated with permitted grazing would no longer occur, which would further reduce dispersal potential via vehicles and horses used by permittees.

The use of prescribed fire to treat sagebrush –grassland communities and timber is not in this alternative. Without treatment, sagebrush would become denser, conifer encroachment into grasslands would continue, and controlled fire breaks would not be created. In addition, no grazing by livestock would lead to build up of fine fuels. These factors could add to the increased risk of large scale wildfires, which as stated above can open up niches previously

dominated by trees and shrubs and reduce competition in these niches, allowing invasive plant species to establish (Jacobs and Sheley, 2003). It is difficult to predict when and where a wildfire may occur or the severity of them, however wildfires are natural across the landscape and bare ground will recover over time but is dependent on slope, aspect, precipitation, fire severity, fire intensity, and elevation. Early detection and rapid response of invasive species following wildfires would be key in minimizing invasive species establishment. There would be 0 (zero) acres of bare soil created through this alternative through prescribed fire.

In summary, Alternative 1 removes known livestock effects to invasive plant species and soils. Soils will recover over time, areas of bare soil will be reduced, vegetation will move towards natural succession, and potential for new infestations would be reduced. No short term increases in bare soil would occur through use of prescribed fire. This alternative has the greatest benefit to minimizing the introduction and spread of invasive species.

Vacant allotments

For vacant allotments the action that is expected to occur would be removal of range improvements that are still on site. The effects would be the same as above for the removal of the improvements. All of the other effects would have already happened. Since livestock have been gone for a number of years, litter would have accumulated, bare ground would be re-vegetated, and plant communities would have shifted towards late succession. Permittee presence on the allotments has been gone for a number of years so reporting and potential treatment of invasive species has not occurred for a number of years. Livestock are no longer a vector for spread of invasive species.

In summary, the actions associated with Alternative 1 for vacant allotments will have already occurred except for removal of range improvements. This alternative would have the greatest benefit to minimizing the introduction and spread of invasive species.

Cumulative Effects

Activities from dispersed recreation and outfitter & guides would continue and still act as vectors of transport of invasive species. Livestock that are authorized under crossing permits to trail across forest to private lands would continue to occur. These activities have occurred for years, are ongoing, and expected to continue in the future. The removal of permitted livestock grazing would reduce the potential for spread of invasive species and the amount of bare soil. As desired conditions for soils and vegetation are met following removal of livestock grazing, vegetation would be more competitive and areas of bare soil would be reduced. Livestock would not act as vectors of spread of invasive species.

In the absence of prescribed fire, it is noted above that the potential for larger scale wildfires could occur. These may occur in areas where invasive species are present, and could expand as a result of the removal of vegetation and the creation of germination sites by bare soil. This is beyond our control, but removal of livestock across the analysis area would reduce the potential spread of weeds. One example of this would ein2003 in the Little Horn project area a wildfire (Little Horn II) burned approximately 7,400 acres. Invasive species were present in the area, but it was unknown as to the actual acres of infestation. It is expected that some new areas of invasive species were started due to the seedbed created by the fire. Follow-up inspections after the fire showed areas that were previously dominated by timber to have cheatgrass and thistle. It is unknown if these were there prior to the fire. With the absence of livestock under alternative 1, there would be a reduction in spread of invasive species through livestock. It is expected however that with the ongoing noxious weeds treatment by counties, and early detection rapid response (EDDR) to invasive threats, that any other ongoing

activities would not lead to any notable increase in invasive species spread or creation of germination sites.

Alternative 2 – Current Management

Livestock grazing would continue under present authorizations through term grazing permits, and allotments that are presently vacant would continue to be so. No prescribed fires would occur under this alternative above and beyond those already authorized under previous NEPA..

Design Criteria

No design criteria for Alternative 1 beyond that described in Chapters 1 and 2 of FEIS.

Direct Effects

Effects are analyzed assuming all Best Management Practices and Grazing Guidelines are being met.

Active allotments

Under Alternative 2, livestock grazing and associated activities (bedgrounds, salting, trailing) would continue to cause some disturbances that result in areas of bare ground, reduced productivity/vigor of some herbaceous vegetation, and a reduction in litter. Where low seral conditions exist in upland and riparian sites and disturbance from livestock is high, weed seeds will find germination sites available and competition from native vegetation to be low. New infestations of invasive species would still have the potential to establish due to existing seed sources, and livestock would remain a vector for potential spread of weed seeds in addition to other multiple use activities such as recreation, timber harvest, and wildlife. Livestock grazing would directly affect litter accumulation, as current levels of grazing would continue, and litter accumulation would be slower under Alternative 2 than Alternative 1 and 3.

Structural range improvements would remain and maintenance and reconstruction of existing improvement would continue. It is assumed that for Alternatives 2 and 3 that reconstruction of existing improvements will occur as needed and the disturbances are already there from the use of these improvements by livestock. Therefore, existing improvement maintenance and reconstruction is not considered to be an additional disturbance for this analysis. Disturbances associated with livestock grazing around the existing improvements are expected to remain the same. No new improvements would be constructed under Alternative 2, and no improvements would be removed so there would be no increase in bare soil associated with either of these activities.

Invasive species, such as Canada thistle and cheatgrass that had been grazed if the timing of livestock in a pasture was right would continue. If the proper timing and intensity is achieved this cultural treatment could maintain or reduce invasive species such as Canada thistle and cheatgrass populations. This is not expected to be a measurable effect among any of the alternatives, because grazing of these species is variable across the landscape and is very limited in any type of concentrated use at present.

Potential transport of invasive plant species by livestock and associated activities will continue under Alternative 2, for active grazing allotments and those vacant allotments that are being authorized under annual authorizations. This could occur through trailing of livestock on or through the allotments, and through deposition of reproductive plant parts off hair and manure.

Meeting allowable use guidelines should minimize potential for propagation and Alternative 2 may have a minimally higher risk of invasive plant propagation than Alternatives 1 and 3.

The use of prescribed fire to treat sagebrush –grassland communities and timber is not proposed in Alternative 2. The only difference between Alternatives 1 and 2 would be fewer fine fuels available under Alternative 2 due to grazing by livestock, which would reduce the opportunity for wildfire to carry through grassland vegetation. Observations on the forest however are that fires do not typically carry through grassland vegetation types (personal observations), so the effects would be similar to Alternative 1. There would be 0 (zero) acres of bare soil created under this alternative through prescribed fire.

In summary, Alternative 2 continues present effects of livestock grazing on herbaceous vegetation, soils, and invasive species. Invasive plant species establishment and spread is expected to continue at the present rate. No new areas of bare soil will be created through prescribed fires or new construction or removal of range improvements.

Vacant allotments

For vacant allotments not authorized under annual authorizations, no livestock grazing activities will occur and structural range improvements will remain on site. No new prescribed fires are proposed, but those under existing NEPA will occur.

In summary, vacant allotments would not be affected under this Alternative because no livestock grazing is presently occurring on them, and no new prescribed fires are proposed. Invasive species would still be present and could be spread by other vectors. The effects would be similar to Alternative 1.

Cumulative Effects

Activities from dispersed recreation and outfitter & guides would continue and still act as vectors of transport of invasive species. Livestock that are authorized under crossing permits to trail across forest to private lands would continue to occur. These activities have occurred for years, are ongoing, and expected to continue in the future. Past and present livestock grazing and associated activities have contributed to the existing conditions seen in the analysis area. The continuation of livestock grazing under this alternative would not add cumulatively. BMPs and Bighorn Vegetation Grazing Guidelines would be met.

In the absence of prescribed fire, it is noted above that the potential for larger scale wildfires could occur. These may occur in areas where invasive species are present, and could expand as a result of the removal of vegetation and the creation of germination sites by bare soil. This is beyond our control, but continued livestock grazing across the analysis area would not contribute above and beyond to what has already been occurring. One example of this is in the Little Horn project area where a wildfire (Little Horn II) burned approximately 7,400 acres. Invasive species were present in the area, but it was unknown as to the actual acres of infestation. It is expected that some new areas of invasive species were started due to the seedbed created by the fire. Follow-up inspections after the fire showed areas that were previously dominated by timber to have cheatgrass and thistle. It is unknown if these were there prior to the fire. With continuation of livestock grazing under alternative 1, there would not be an incremental effect in spread of invasive species through livestock. It is expected however that with the ongoing noxious weeds treatment by counties, and early detection rapid response (EDDR) to invasive threats, that any other ongoing activities would not lead to any notable increase in invasive species spread or creation of germination sites.

Alternative 3 – Proposed Action

Alternative 3 would allow livestock grazing under adaptive management strategies across the analysis area. Some allotments or portions thereof that were formerly vacant would be stocked permanently under term grazing permits (Red Canyon C&H, Grouse Creek S&G, Willow S&G, Leigh Creek S&G, McLain Lake S&G). Other vacant allotments would be used as forage reserves (Hunt Mt S&G, Red Canyon S&G), and the remaining would stay vacant (Tourist Horse, Stull Lakes) In addition, approximately 32,788 acres of sagebrush-grassland and timber communities would be treated through prescribed fire, mechanical, and/or chemical treatments in the Beaver Creek and Little Horn project areas. Effects are analyzed assuming all Best Management Practices and Bighorn National Forest Vegetation Grazing Guidelines are being met.

Design Criteria

No design criteria for Alternative 1 beyond that described in Chapters 1 and 2 of FEIS.

Direct Effects

Active allotments

Under Alternative 3, livestock grazing under adaptive management strategies are expected to move areas in low seral condition towards desired conditions quicker than Alternative 2, but more slowly than Alternative 1. In turn, germination sites for weed seeds are expected to be reduced due to improved competition from desirable species. New infestations of invasive species would still have the potential to establish due to existing seed sources, and livestock would remain a vector for potential spread of weed seeds in addition to other multiple use activities such as recreation, timber harvest, and wildlife. Livestock grazing would directly affect litter accumulation, as current levels of grazing would continue, and litter accumulation would be quicker under Alternative 3 than Alternative 2, but slower than Alternative 1.

Where low seral conditions exist in upland and riparian sites and disturbance from livestock is high, weed seeds will find germination sites available and competition from native vegetation to be low.

Livestock grazing would directly affect litter accumulation, and would be similar for alternative 2 and 3. New infestations would still have the potential to establish due to existing seed sources, and livestock would remain a vector for potential spread of weed seeds in addition to other multiple use activities such as recreation, timber harvest, and wildlife.

The majority of existing structural range improvements would remain and maintenance and reconstruction of would continue. It is assumed that for Alternatives 2 and 3 that reconstruction of existing improvements will occur as needed and the disturbances are already there from the use of these improvements by livestock. Therefore, existing improvement maintenance and reconstruction is not considered to be an additional disturbance for this analysis. Disturbances associated with livestock grazing around the existing improvements are expected to remain the same as under Alternative 2, so there would not be an increase in bare soil. A few range improvements under Alternative 3 would be removed, and new improvements are proposed for construction. New construction activities and removal of existing improvements will cause some ground disturbance but this is expected to be minimal in size, and would be expected to be less than Alternative 1, but slightly greater than alternative 2. Invasive species, such as Canada thistle and cheatgrass that had been grazed if the timing of livestock in a pasture was right would continue. The effect is expected to be the same as under Alternative 2.

Potential transport of invasive plant species by livestock and associated activities will continue under Alternative 3, for active grazing allotments, forage reserves or/and allotments that were previously vacant. This could occur through trailing of livestock on or through the allotments, and through deposition of reproductive plant parts off hair and manure. There is expected to be a slight increase of risk for transport of reproductive parts by livestock on the allotments that were previously vacant. It is expected that by meeting and moving towards desired conditions through allowable use guidelines and adaptive management strategies, there would be minimal potential for propagation should any weed seeds be transported. In addition, continued early detection and rapid response approach to noxious weed management is expected to minimize spread and eradicate new infestations.

The use of prescribed fire, mechanical and/or chemical treatments is proposed across approximately 32, 788 acres in alternative 3 within sagebrush-grassland and timber communities in the Beaver Creek and Little Horn project areas. This does not mean that all 32, 788 acres would be treated, nor would the burns occur all in the same time frame. Burn plans will be developed that outline burn units and prescriptions for ignition within these 32, 788 acres. There are variables such as slope, aspect, fine fuels, density of vegetation, soil and vegetative moisture, cloud cover, and weather factors that all can affect the actual burn patterns, and amount of fuels consumed. Typically prescribed fires are also conducted in a mosaic pattern; however larger contiguous areas of black may also occur. Based on past observations of other prescribed burns on the forest, it is estimated that an average of approximately 35% of these acres would actually have vegetation consumed by prescribed fire activities. Based on these figures then, approximately 11,475 acres could potentially have vegetation, litter, and any other ground cover or overstory removed. Of these acres, it is estimated that approximately 10%, (1,148 acres) could have residual effects to the soil that could provide an opportunity for invasive species to establish. Through the use of prescribed fire, the intensity of the fire can be controlled and minimize residual soil effects if within prescription. However, there may be some effects where sagebrush has out-competed the herbaceous understory and is so dense that fire is sustained in consumption of the stobs. Design criteria would include developing burn plans to avoid areas where known invasive species exist, following prescribed fire prescriptions, following grazing guidelines and allowing for adequate post fire recovery before grazing. Assuming that design criteria is adhered to, the risk of invasive species establishment through use of prescribed fire or mechanical treatments should be minimized.

For the remaining three project areas including Rock Creek, Tensleep Canyon, and Goose there is no prescribed fire proposed so the effects would be the same for alternatives 1 and 2 as described above.

Spikemoss (*Selaginella densa*) treatment is proposed through use of a mechanical harrow or chisel in 50-300 acres plots within the Tourist, Rapid Creek C&H, and Goose Creek C&H allotments. Spikemoss treatment would directly disturb the soil surface. Soil mixing would occur at a depth of approximately 4-6 inches, the soil surface roughness would be increased, and spikemoss would be uprooted and buried into the soil profile. This activity is expected to break up the spike moss mat and allow for revegetation of native species. Treatment areas would be on upland sites with less than 10% slopes and away from the water influence zones. Treatment areas would be seeded with a native seed mix if natural plant re-establishment does not occur, and would be given adequate time to re-vegetate before livestock grazing occurred again in the future. This would provide the soil with re-vegetative capabilities, and minimize the risk of invasive species establishment. The Air, Soils, Geology Specialist's Report found in the project file describes effects of spikemoss treatment on the soil resource. It describes both soil disturbance and ground cover effects and was reviewed and is incorporated by

reference in this report. Assuming that design criteria is adhered to and the mechanical treatment occurs as described, the risk of invasive species establishment should be minimized. Effectiveness monitoring will include observations for any invasive species, and should any be found immediate treatment would occur.

In summary, alternative 3 poses the greatest risk for bare soils to occur through the use of prescribed fire, which in turn provides for bare areas for potential invasive species establishment. It is expected that following design criteria will minimize the potential for invasive species to establish. On the other hand, Alternative 3 poses the least risk of the three alternatives for wildfires which may occur in areas invasive species already exist. This could create a seed bed ripe for establishment and expansion. Areas of bare soil created by removal and new construction of range improvements are expected to be minimal due to the small size of any areas of disturbance. Alternative 3 would have the highest potential of the three alternatives for invasive species to establish or spread, but design criteria would minimize these effects.

Vacant allotments (Willow, Leigh Creek, McClain Lake, Hunt Mountain S&G, Red Canyon S&G, Red Canyon C&H, Grouse Creek C&H)

For these vacant allotments, livestock grazing is proposed to occur on parts of Willow S&G, Leigh Creek S&G and McClain Lake S&G under existing term grazing permits, and on all of Grouse Creek C&H and Red Canyon C&H. In addition, Hunt Mt S&G and Red Canyon S&G would be forage reserves. Since livestock have been gone for a number of years, litter would have accumulated, bare ground would be re-vegetated, and plant communities would have shifted towards late succession, which allows for better competition with invasive species. Livestock and associated activities would become vectors for spread of invasive species on these allotments and the potential for transport of invasive species would increase under this alternative for these allotments that were formerly vacant. No new prescribed fires are proposed under Alternative 3 on any of these vacant allotments so there would be no direct effects from prescribed fire.

In summary, formerly vacant allotments becoming active would be expected to have some potential for increased spread of invasive species due to livestock activities, but the effects are expected to be minimized due to adaptive management strategies. Alternative 3 would have the greatest potential for introduction and spread of invasive species on vacant allotments due to the re-introduction of livestock grazing.

Cumulative Effects

Activities from dispersed recreation and outfitter & guides would continue and still act as vectors of transport of invasive species. Livestock that are authorized under crossing permits to trail across forest to private lands would continue to occur. These activities have occurred for years, are ongoing, and expected to continue in the future. Past and present livestock grazing and associated activities have contributed to the existing conditions seen in the analysis area. The continuation of livestock grazing under this alternative would not add cumulatively. BMPs and Bighorn Vegetation Grazing Guidelines would be met, and adaptive management strategies would be implemented as needed.

In the absence of prescribed fire for the Rock Creek, Tensleep Canyon, and Goose project areas, the cumulative effects would be the same as in Alternative 2.

For the Little Horn and Beaver Creek project areas, prescribed fires are proposed to occur which would lead to some areas of bare soil. However with the use of prescribed fires for vegetative treatments, this would provide potential fuel breaks which may reduce the size of

larger wildfires. Even in the presence of prescribed fires, wildfires may still occur at large scales if sufficient conditions exist that would carry a fire. With the continuation of livestock grazing under Alternative 3, and presence of livestock on vacant allotments, there would not be any incremental effects above and beyond those already occurring.

Table 2. Differences between alternatives for risk of invasives to be carried or establish

Indictor	Alt 1	Alt 2	Alt 3
Potential acres of bare soil through prescribed fire	0 acres	0 acres	1,147 acres
# of range imps removed	All (5)	None (0)	Few (2)
# new range imps	None (0)	None (0)	Several (3)
Wildfire potential	High (5)	High (4)	Low(1)
Livestock as vector	No (0)	Yes (5)	Yes (5)

Scale 0-5 with 0 being none or no risk to 5 being all or high risk

Compliance with Forest Plan and Other Relevant Laws, Regulations, Policies and Plans

Recommendations made within this report follow the direction provided in the revised Forest Plan. The Forest Plan was prepared to meet laws and regulations such as the Forest and Rangeland Renewable Resources Planning Act (1974), NFMA (1976), and NEPA (1969).

The Bighorn National Forest Plan (2005) provides the following direction for Non-native and Invasive Species and are found on page 1-50 to 1-51 and were considered as follows:

Non-native and Invasive Species

Standards

1. Determine the risk of noxious weed introduction or spread and implement appropriate mitigation measures for all proposed projects or activities. Use the *USFS Guide to Weed Prevention Practices* (2001). The risk of specific species, or the risk of invasives in general, are discussed above.
2. Use only certified "noxious weed free" hay or straw for feed. This is a special order on the forest and is being implemented.
3. Use only certified "noxious weed free" seed, mulch, and straw for revegetation and erosion control projects. This is done on projects; none of the activities specified in these alternatives
4. Manage invasive plant species using integrated management techniques, including mechanical, chemical, prescribed fire, and biological control methods. This is being done with agreements with counties for treatment on an annual basis.

5. Include provisions that are necessary to prevent the spread of noxious weeds in contracts and permits for use of NFS lands and resources. Special order on the forest for weed free feed is being implemented, timber sale contracts call for cleaning of equipment.

Guidelines

1. Develop an invasive species management program to include noxious weeds and pest management that addresses the following components: awareness, prevention, inventory, planning, treatment, monitoring, reporting, and management objectives. Forest Invasive Action Plan has been developed and updated (2008).
2. Set priorities for managing invasive plants including noxious weeds based on the following: Considered in planning treatment.
    a. Prevent the introduction of new invaders
    b. Conduct early treatment of new infestations
    c. Contain and control established infestations.
3. Give consideration to the following when setting priorities for the treatment of invasive plants including noxious weeds: Considered in planning treatment
    a. Overall threat of the species including rate of spread and difficulty of treatment
    b. Invasions found within special management areas, for example Research Natural Areas, Wildernesses, and other areas of concern
    c. Probability that the treatment strategy will be successful
    d. Refer to state of Wyoming BMPs.
4. To reduce transport or establishment of noxious weed seeds, wash all equipment used in ground-disturbing or fire suppression operations (except for initial attack) prior to arrival on the forest. This is done.
5. Conduct archeological review of pesticide or herbicide spraying within ¼ mile of petroglyph or pictograph properties. None present in area.

Monitoring Recommendations

Monitoring Objective	Monitoring Type	Responsibility	Approx. Frequency
Monitor spikemoss treatment areas for invasive species or noxious weeds	Ocular survey of the treatment area(s).	Forest Service Rangeland Management Personnel with input from affected Grazing Permittee(s)	Annually until observations determine invasive species or noxious weeds are absent for two consecutive years. If invasive species or noxious weeds are found, they will be treated.

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